LOCAL PERCEPTIONS OF CLIMATE CHANGE AND ADAPTATION STRATEGIES IN THE MANAGEMENT OF *SENEGALIA SENEGAL* PARKS IN NIGER

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Introduction

Climate change is one of the biggest challenges facing humanity in the 21st century. Africa is one of the most vulnerable continents to climate variability and change because of multiple stresses and low adaptive capacity (IPCC, 2007). Sub-Saharan Africa in particular the Sahel case has the distinction of being especially vulnerable to climate change because of geographical conditions that expose them more to climate factors, their low incomes, and greater dependence on activities sensitive to climate such as agriculture (Amoukou, 2009). Niger has a Sahelian climate, ecosystems are fragile and the country is highly vulnerable to climate change phenomena. Furthermore, the difficult socio economic context weakens the adaptability of agricultural systems.

However, perceptions and strategies for adaptation to climate change of these ecosystems, particularly *S. Senegal* parkland, are hardly studied despite the multitudes of services they provide to rural communities. Therefore the Young Team Associated with the IRD (JEAI) conducted a study to analyze farmers' perceptions of climate change and identify adaptation measures as part of *S. senegal* parkland management in the three gum basins in Niger.

Matérial and methods

Parklands of *Senegalia senegal* (syn. *Acacia senegal*) located in three basins of gum arabic production in Niger were included in the study. The choice of survey villages was done using the criteria of Gnangle et al. (2012) and Diarassouba et al. (2008), i.e. the importance that farmers give to the *Senegalia* parks in the village, the availability of operational parks of *Senegalia*, socio-economic diversity, socio-cultural features and accessibility of the village. The survey methods used were semi-structured interviews and focus groups. Respondents were randomly selected individually. The number of respondents in each village was derived from the number of farm household data from the general census of the population of the habitat (INS, 2012). Thus 38 and 49 farmers were surveyed in Kokoyé and Kiki, respectively, i.e. 10% of the number of agricultural households of these sites, and village assemblies were organized in other localities (Aseye, Bader Goula, Malam Mainari and N'Guel kolo). Respondants were farmers of different age classes (very young, young, adult and seniors). They were classified as extremely vulnerable, very vulnerable, moderately vulnerable or not vulnerable depending on annual food production and livestock capital.

The frequency response of the perceptions and the adaptive strategies were calculated and the frequency of histograms was performed using the Excel spreadsheet. The Chi-Square test of independence was used to check whether there was independency between perceptions and socio economic characteristics (vulnerability levels and age groups). The Correspondence Analysis (CA) was performed using the R software (R Core development T.2010) to connect perceptions groups to socioeconomic characteristics.

Results

Farmers' perceptions of climate change

A total of 11 perceptions of climate change have been identified by the peasants of the surveyed localities (**Table 1**). The most cited perceptions are: the high wind speed; the drying up of rivers; the reduction of yield crops; loss of biodiversity; and the rising temperature. They account for 72.42% of total collections of which 91.67% were natural factors and 8.33% socio-cultural factors. Some perceptions, such as short drought (chi-square=41,14; $p<0,001$) temperature rise (chi-square=28,57; $p<0,001$), strong wind speed (chi-square=37,75; $p<0,001$), declining crop yields (chi-square=34,57; $p<0,001$), drying up of water sources (chi-

square=37,78; p<0,001) and loss of biodiversity (chi-square = 41,14; p<0,001) were dependent on the level of vulnerability and the age of the farmers.

Table 1: Farmers' perceptions of climate change

Farmers perceptions of climate change	Relative frequency of responses (%)	Factor origin
Strong wind speed	12,36	Natural
Drying up of rivers	12,36	Natural
Low cover of vegetation	12,07	Natural
Lower yield of crops	12,07	Natural
Loss of biodiversity	12,07	Natural
Temperature rise	11,49	Natural
No social compliance	8,33	Socio-cultural
Late rains	6,32	Natural
Early cessation of rains	6,03	Natural
Rainfall decline	6,03	Natural
Short drought	0,86	Natural
Total of frequency	**100**	

The projection of vulnerability levels and farmers' perceptions in the axis system from the Correspondence Analysis (CA) is presented in **Figure 1**. The vulnerable farmers perceived climate change by decreasing rainfall and delayed rains while extremely vulnerable perceived it through non-compliance with social standards, the early cessation of rains, declining crop yields and the drying-up of water sources (**Figure 1**).

The results of Correspondence Analysis linked age groups and farmers' perceptions of climate change (**Figure 2**). Older farmers express different perceptions of climate change in relation to young farmers. Indeed, the older farmers perceived climate change by decreasing rainfall and drought pockets while young farmers perceived it through late rains and early cessation of rains.

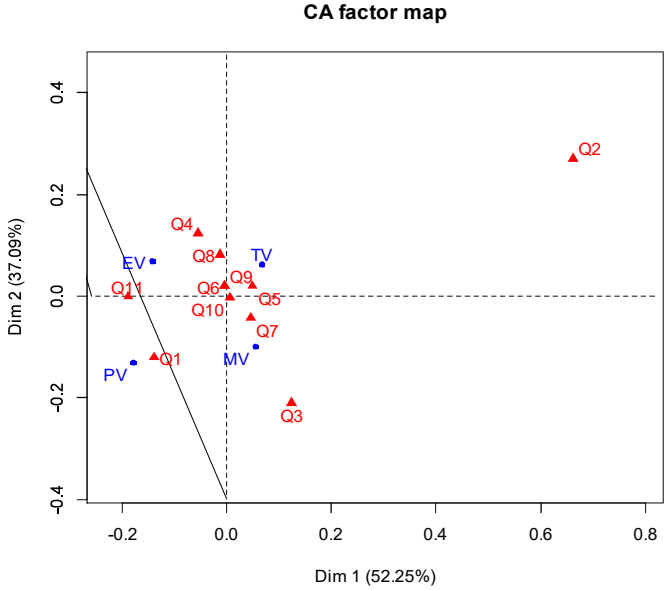

Figure 1: Map of the Correspondence Analysis (CA) PV: Not vulnerable; MV Moderately vulnerable; TV: Very vulnerable; EV: Extremely vulnerable; Q1: Decrease in rainfall; Q2: Short drought; Q3: rain delay; Q4: Early end to rain; Q5: Rising temperature; Q6: Strong wind speed; Q7: Low cover of vegetation; Q8: Decline in yield of crops; Q9: Drying up of rivers; Q10: Loss of biodiversity; Q11: No respect of social norms

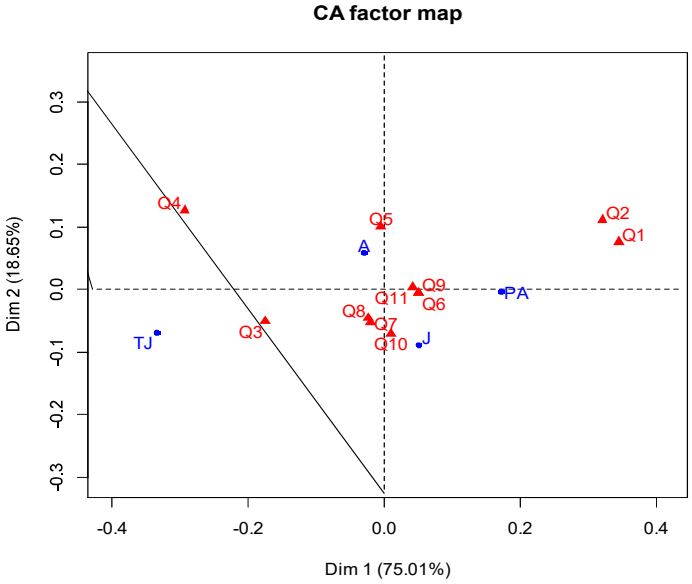

Figure 2 : Map of the Correspondence Analysis (CA) TJ: Very young, J: Young, A: Adults, PA: Seniors;; Q1: Decrease in rainfall; Q2: Short drought; Q3: rain delay; Q4: Early end to rain; Q5: Rising temperature; Q6: Strong wind speed; Q7: Low cover of vegetation; Q8: Decline in yield of crops; Q9: Drying up of rivers; Q10: Loss of biodiversity; Q11: No respect social norms

The investigation found that the disappearance of species in the *Senegalia* genus is perceived by adult's farmers (45.64%). Indeed, adults farmers perceived that the *S. senegal* is the most endangered species (17.45%) followed by *S. seyal* (14.77%) and *S. laeta* (13.42%).

Adaptative strategies to climate change in *S. Senegal* parkland management

Eleven of adaptation strategies to climate change have been identified in the surveyed village's lands, of which 81.81% are of endogenous origin and 18.18% of exogenous origin (**Table 2**). The strategies most adopted by farmers are: the valorization of lowlands; planting valuable species; the practice of assisted natural regeneration (ANR); the use of improved seeds and diversification of activities.

The survey also revealed five important endogenous measures practiced for sustainable management of *S. Senegal* parkland system: the fight against the cutting of green wood; assisted natural regeneration (ANR); restocking/plantation; deferred grazing and finally the establishment of village management committees.

Table 2: Farmers adaptative strategies to climate change

Farmers adaptative strategies	Relative Frequency of responses (%)	Origin
Valorization of lowland	18,75	Endogenous
Restocking and planting of valuable species	15,63	Endogenous
Protection of *Senegalia* seedlings (assisted natural regeneration)	14,73	Endogenous
Use of improved seeds	11,16	Exogenous
Diversification of activities	9,38	Endogenous
Changing the type of crops	7,59	Endogenous
Manure use	6,70	Endogenous
Use of mineral fertilizers	5,36	Exogenous
Changing sowing dates	4,02	Endogenous
Development and operation of ponds	4,02	Endogenous
Magical –religious pratices	2,68	Endogenous
Total frequency	**100**	

Discussion

Farmers' perceptions of climate change

The study highlighted several farmers' perceptions of climate change. Perceptions such as high winds, the drying up of water sources, declining crop yields and loss of biodiversity revealed in the study are consistent with those found by Amoukou (2009) in the Niger basin. According to this author climatic factors (drought) and anthropic factors (cutting green wood) are causing the disappearance of vegetation and migration of wildlife to the south. The work of Gnanglé et al. (2012) in the north of Benin and (2009) in the center of Benin and that of Hassan et al. (2008) in sub-Saharan Africa and Traore et al. (2002) in Guinea have revealed more than half of the surveyed farmers perceived climate change through rising temperatures, declining rainfall, changing in the timing of the rains, recurring droughts and the drying up of once perennial rivers in the dry season.

In this study, it appeared that farmer's perceptions of climate change are dependent on the level of vulnerability and age groups (very young, youth, adults and seniors) farmers. These results are similar to those found by Gnanglé et al. (2012) in northern Benin and also corroborate those of Teka et al. (2010), which found in coastal areas of Benin that local perceptions of natural factors on people vary according to specific groups (social group and age). Adults and very vulnerable farmer's better express perceptions of climate change on *S. Senegal* parkland system. This is explained by the fact that these farmers have as main activity the exploitation of natural resources. Their annual agricultural production is highly insufficient (hardly exceed six months of consumption), so they fall back mainly on *Senegalia* parks exploiting gum and wood, deriving substantial income for them. The analysis of the results on the perception of the population could be an extremely important tool for sustainable management of *Senegalia* parklands.

Local adaptative strategies to climate change

Adaptation is a climate risk management process by implementing individual and collective measures for the prevention, response and recovery (Gnanglé et al, 2012; IAVS, 2011). The results of the study highlight the strategies of adaptation both collective and individual, which corresponds to the above definition suggested by these authors. This is the case of pond facilities, magical-religious practices (collective) as opposed to individual strategies such as the use of improved seeds, the practice of assisted natural regeneration (ANR). The same observations were made by Gnanglé et al. (2012) and Traore et al. (2002), which identified both

individual and collective strategies in their study areas. The valuation of the lowlands, the practice of assisted natural regeneration (ANR), the use of improved seeds and planting of valuable species (*Adansonia digitata, Senegalia Senegal, Tamarandus indica* ...) were the adaptation strategies most adopted by the farmers of the study area. These coping strategies were identified in the Niger basin by Amoukou (2009). Traore et al. (2002) found similar results in Guinea-Conakry.

Other practices are carried out by the rural communities in the study area, for example the collective prayer meetings to implore " *Allah* " for fruitful winters. This practice of collective adaptation was observed by Teka et al. (2010) on the Benin coast and Brou et al. (2005) in rural communities in Ivory Coast through ritual and magical-religious practices. The farmers of the three basins of gum production in Niger have adopted strategies of adaptation from their perceptions of climate change in most cases. These results corroborate Bryant et al. (2000) who said that the climate change adaptation springs from translating perceptions of climate change into agricultural decisions.

These strategies need to be evaluated scientifically in order to determine the most relevant strategies contributing to the reduction of vulnerability as well as the adaptation of societies and ecosystems to climate change.

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